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S. Banerjee, P. Phelan, R.W. Foulke

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Impulse Drying Sludge

Sujit Banerjee, Paul Phelan, Russell W. Foulke

Institute of Paper Science & Technology
500 Tenth Street, N.W.
Atlanta, GA 30318-5794

Abstract

In a new approach to energy-efficient sludge dewatering, sludge is contacted briefly under pressure by a hot surface. The steam generated at the interface between the sludge and the surface forces out some of the water in liquid form. A laboratory demonstration with belt-pressed primary sludge from a paper mill removed more than ten additional percentage points of water.

Impulse drying was developed for drying paper (1,2). The wet paper sheet contacts a hot roll, and the steam pressure generated at the roll-sheet interface expels some of the water in <u>liquid</u> form, thereby conserving the energy that would otherwise be required for evaporation. A difficulty is that pressure differentials developed within the sheet may cause delamination (3-7), and special roll surfaces have been developed to control heat transfer to the sheet (8,9). Since delamination is not an issue with sludge, a laboratory simulation with an electrohydraulic press was conducted to determine whether the impulse drying concept could be applied to sludge.

The press used (illustrated in Figure 1) was designed to simulate the transient mechanical and thermal conditions, and the pressure profile that a sample would experience in a commercial impulse dryer. The thermal profile was simulated by using a platen of the same composition as the surface of the roll press maintained at the operating temperature of the process. As the dominant direction of flow is out-of-plane, the electrohydraulic press provides an excellent simulation of the impulse drying process (10).

A blotter is placed between the sample and the felt to impede solids movement to the felt. The sample, blotter, and felt are weighed before placement in the nip. The hydraulic system is activated to give a haversine pressure pulse of 140-1500 ms duration and a peak pressure between 400 and 1200 psi. The sample, blotter, and felt are reweighed after the impulse, and the water removal calculated. For paper, the water loss compares well with values obtained from the IPST's pilot impulse dryer.

Primary sludge from Riverwood international's Macon GA facility was belt pressed at the mill to 30% solids. The mill produces liner and coated board and uses 50% recycle. The sludge was sent to Ashbrook Corp. where it was dewatered to 39% solids using their state-of-the-art high solids (14 roll) Winklepress. We were able to impulse dry the same sludge to 50%+ solids, as shown in Figure 2 (11). This figure is only one example of multiple measurements made at different temperatures and nip residence times. The lower line reflects a run at room temperature where the cold roll essentially acts as a press. The upper line shows that impulse drying at 350°C takes the solids level to almost 60%. A small part of the water lost is released as steam. If the yardstick is weight gained by the blotter instead of weight lost by the sludge, then the solids level attained by liquid water loss is 52%, with the remainder evaporating as steam. However, the steam loss is probably somewhat lower because the blotter does not capture all the water. The two lines in Figure 2 are projected to meet at the ingoing solids level at zero pressure, which means that little evaporation occurs when the hot surface is lightly placed on the sludge. The dwell time of 0.7 seconds is optimum for this sludge; shorter dwell times lead to reduced dewatering, whereas longer periods increase evaporative loss.

In other work, another sample of Macon sludge (belt pressed to 30% solids at the mill) was pressed further by Ashbrook to 40% solids. We then impulse dried the Ashbrook-processed sludge to 50%. However, only 5 percentage points were now lost as liquid water, with the rest escaping as steam - a much smaller loss than the Figure 2 result. This probably occurs because a lower steam pressure is generated with the higher (40%) solids, which suggests that impulse drying is most efficient when there is sufficient water available to build up steam pressure at the interface. Our preliminary work suggests this optimum water to be at about 30% solids for the sludge used, which is typical of the performance of an inexpensive belt press. Hence, these experiments demonstrate the potential of retrofitting existing belt presses with an add-on impulse dryer.

In summary, we have demonstrated the potential of impulse drying to sludge. The ten additional percentage point expression of water in liquid form has major cost reduction potential for either sludge burning or landfilling. While the Macon sludge was relatively easy to dewater on account of its high ash content, we have, in preliminary work, been able to remove more than 5 percentage points of water from belt-pressed municipal sludge.

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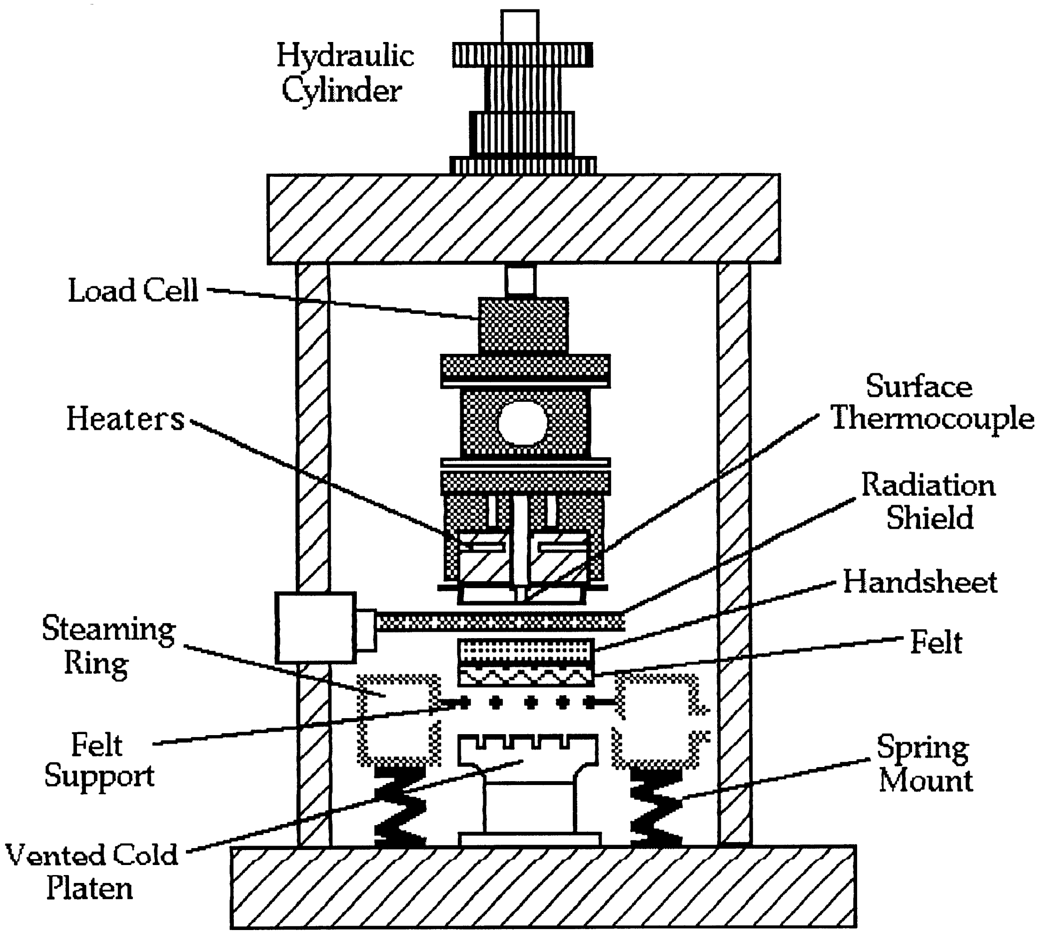

Figure 1. Schematic of the electrohydraulic press.

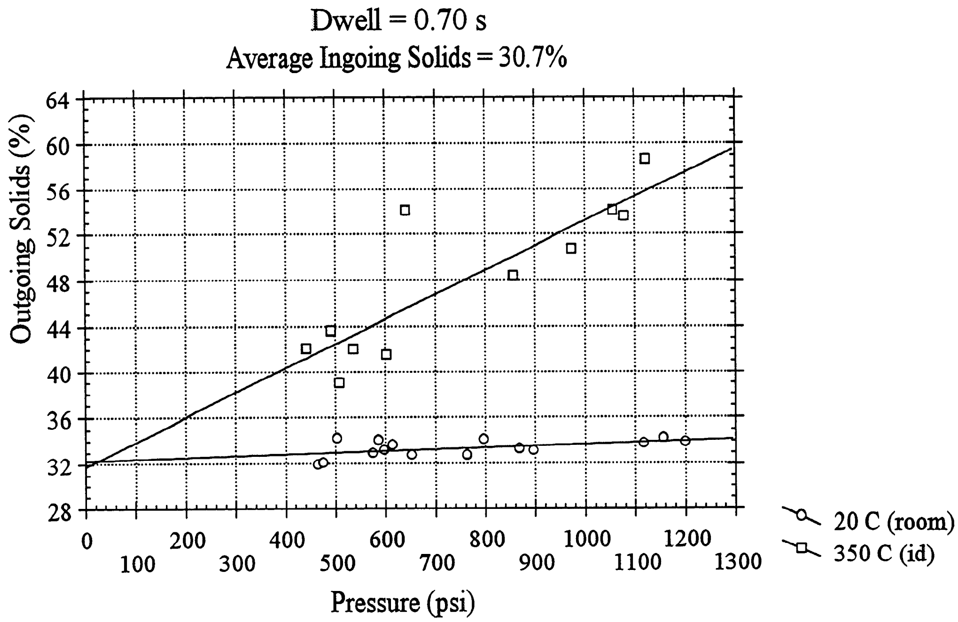

Figure 2. Impulse drying of primary sludge from Riverwood's Macon mill